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FILLER METAL FOR DIFFUSION BRAZING

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/1[1]

SPECIFICATION

1. Title of the Invention

   Filler Metal for Diffusion Brazing

2. Scope of Patent Claims

   A filler metal for diffusion brazing consisting of

   Cr 14 ~ 16 % (wt %, the same hereinafter)

   Co 9 ~ 11 %

   Al 3 ~ 5 %

   Mo 4 ~ 6 %

   B 2 ~ 4 %

   Ni balance.

3. Detailed Description of the Invention

   [Field of Industrial Application]

This invention relates to an improvement of a filler metal used for repairing cracks in an N-based or Co-based superalloy or the like by diffusion brazing.

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[1]Numbers in the margin indicate pagination in the foreign text.

[Prior Art]

For instance, as filler metals for diffusion brazing used for repairing a cracked portion of an Ni-based or Co-based superalloy of a turbine vane and others, a filler metal powder containing a melting point depressing element has been uniformly mixed for use with a brazing base powder based on a superalloy.

Among the filler metals, a filler metal having a standard composition of 15Cr-10Co-3Al-3Ta-2.5B-balance Ni is expensive and has a problem in that it lowers the impact value in the case of a wide gap because Ta is added thereto.

Moreover, a filler metal having a composition of 14Cr-9.5Co-3.5Al-2.5B-balance Ni is also given; however, it has a problem of low strength because a solid solution reinforcing element, such as Ta, Hf, Mo, W, Nb, or the like is not added thereto.

Furthermore, a filler metal having a composition of 4C-19Cr-8Si-8B-4W-16.5Ni-balance Co has a problem that a deposit grows in the shape of dendrites and reduces the strength because Si is added as a melting point depressing material.

Still further, the strength of a filler metal consisting of Ni-Cr-B, such as 15Cr-3.5B-balance Ni, or Ni-Co-Si-B, such as 17Co-4Si-2.7B-balance Ni, abruptly reduces the strength in the

case of a high temperature or a wide gap, thus it is undesirable.

(Problem to Be Solved by the Present Invention)

In view of the above situation, the object of the present invention is to provide a filler metal that gives a brazed zone having a high high-temperature strength and a large normal-temperature impact value at a wide gap by using a superalloy as a brazing base material and mixing it therewith in diffusion brazing.

(Means for Solving the Problem)

The present invention relates to a filler metal for diffusion brazing consisting of

Cr 14 ~ 16 %

Co 9 ~ 11 %

Al 3 ~ 5 %

Mo 4 ~ 6 %

B 2 ~ 4 %

Ni balance.

For repairing surface cracks or a damaged area of a part with an Ni-based or a Co-based superalloy as a material, such as a turbine vane, it is common to clean the location by a well-known method such as a method based on a fluoride ion or a

hydrogen reduction method or the like. Next, a filler metal powder obtained by uniformly mixing a brazing base powder and made into a paste-like or tape-like filler metal for diffusion brazing with an acrylic resin binder is set to a part to be repaired, and then the part is brazed by heating in a vacuum. The application of the brazing filler to the surface damaged area is also carried out by a low-vacuum thermal spraying method and subsequently hot pressing with a static water pressure.

The high-temperature tensile strength, the stress rupture strength, and the impact value are required as the repairing strength at this time; however, the use of a commercial filler metal powder is insufficient, and a filler metal powder having an ingredient composition in which a balance with the brazing base powder ingredient is considered must be used for satisfying the desired strength by such a strength test.

Since the use of a rare element such as Ta or Hf or the like as a solid solution reinforcing ingredient for increasing the high-temperature strength has a problem with increasing the cost, Mo or W is preferable. Mo is used in the present invention by considering the balance with the brazing base powder composition, and its amount is 4 ~ 6 %.

When a deposition enhancing alloy is used in the brazing base powder composition, a small amount of either Al or Ti must

be supplemented in the filler metal so as not to consume γ' phase $Ni_3(Al, Ti)$ in the brazing base, and therefore Al is 3 ~ 5 %, preferably 3 ~ 4 %, in the present invention.

For other ingredients, Cr 14 ~ 16 %, Co 9 ~ 11 %, B 2 ~ 4 % and balance Ni are used by reference to 14Cr-9.5Co-3.5Al-2.5B.

As brazing base powders used with the filler metal powder of the present invention, the IN100 alloy powder shown in Table 1 is suitable as the filler metal powder of the present invention, and if the ratio of the brazing base powder and the filler metal powder is within the range of 5 to 5 or 6 to 4, both the texture and the strength show satisfactory results.

If the powder particle size is 48 μm or less, this is convenient because the brazing powder fully flows into cracks at the minimum width (about 0.05 mm).

(Embodiment examples)

Next, embodiment examples will be described. Surface damage is generated at the surface of a turbine blade as shown in 1 of Fig. 1 and 11 of Fig. 2, and therefore it is repaired. Standard ingredient compositions for the brazing base and the filler metal are shown in Table 1.

Table 1 (%)

元素	部品材料 C1023*	ろう母材 IN100	添加材
Cr	15.5	12.57	15
Co	9.7	13.44	10
Al	4.1	4.97	4
Fe	0.5	0.1	—
Mo	8.3	3.23	5
Ti	3.6	4.27	—
C	0.15	—	—
W	0.2	—	—
B	—	—	3
Ni	残	残	残

A	B	C	D
	E	E	E

Note. *Si 0.2 max, Mn 0.2 max, and Nb 0.25 max

Translator's note:

A Element

B Parts material C1023*

C Brazing base IN100

D Filler metal

E balance

/3

30 % of an acrylic resin was mixed as a binder with a mixed powder of this brazing base and a filler metal, kneaded into a paste, and set to a part to be repaired as illustrated, and then it was heated in a vacuum of 10^{-4} mmHg mercury by a heating cycle exemplified in Fig. 3 to be diffusion brazed.

Impact test pieces were sampled from a brazed zone to make a normal temperature test, and the results are shown in Table 2 by comparing the samples with the result of controls. Sample (1) in the table relates to the present invention, (2) and (3) are samples using commercial products as controls, and the combination of the brazing base and filler metal is X-40 and H-33 in sample (2) and Rene 80 and D-15 in sample (3).

From Table 2, it is known that the impact strength and the base strength ratio of the invented sample is markedly more excellent than the same control (3), and the base strength ratio also shows the same level of results as compared with control (2) having a low parts strength.

Table 2

試料	部品強度 kg・m/cm²	ギャップ補修強度 kg・m/cm²				
		0.08	0.25	0.50	1.02	
(1)	2.45	3.2	2.8	1.8	1.7	*1
		130.6	114.3	73.5	69.4	*2
(2)	1.45	1.28	1.60	1.77	1.36	*1
		88.0	110.0	122.0	94.0	*2
(3)	2.45	1.65	1.86	1.49	1.13	*1
		32.0	35.0	29.0	22.0	*2

A	B	C			

Note *1: impact strength, *2: base strength ratio (%)

Translator's note:

A Sample

B Parts strength

C Strength by gap width kg≅m/cm^2

[Effects]

As is described above, the filler metal for diffusion brazing does not contain expensive elements such as Ta and/or Hf or the like for increasing the high-temperature strength, the filler metal is cheap because it contains Mo instead of the elements, and the generation of dendritic crystal is not a concern, because it contains B instead of Si as a a melting point depressing element. The result of fully satisfying necessary properties of the brazed zone, such as strength, impact value, and so on, is obtained, and thus the present invention has very large effects in practice.

4. Brief Description of the Drawings

Fig. 1 is a cross-sectional view showing a repaired state of cracks, Fig. 2 is a cross-sectional view showing a repaired state of a surface damaged part, and Fig. 3 is a diagram showing a heating cycle for diffusion brazing.

1 crack

11 surface damaged area

2 brazing filler

Fig. 1

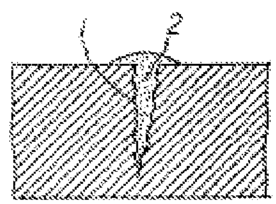


Fig. 2

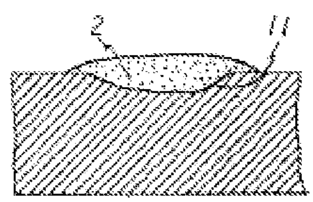
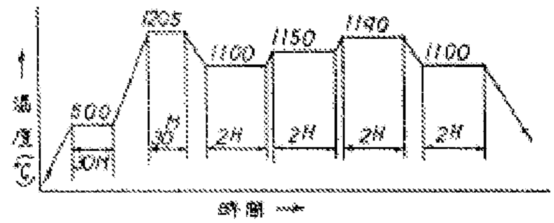


Fig. 3



Y Axis: Temperature (° C)

X Axis: Time